We claim:

1. A mechanically fastened composite joint, comprising:
   (a) a substrate material;
   (b) a multi-layered composite mechanically joined to said substrate material by at least one fastener, said composite including:
      (i) a pair of resin-impregnated, fiber-containing layers, having a first toughness;
      (ii) a fiber-containing core layer having a second, greater toughness than said pair of resin-impregnated fiber-containing layers, said fiber-containing core layer sandwiched between said pair of resin-impregnated, fiber-containing layers;

said composite joint having improved resistance to damage caused by externally applied forces.

2. The composite joint of claim 1 wherein said fiber-containing core layer comprises polymeric fibers and said pair of resin-impregnated, fiber containing layers comprise glass fibers.

3. The composite joint of claim 1 wherein at least one of said pair of resin-impregnated, fiber-containing layers comprises a fiber having a first tensile modulus and a first elongation at break, and said fiber-containing core layer comprises a fiber having a second, tensile modulus which is lower than said first tensile modulus, and a second elongation at break which is higher than said first elongation at break.

4. The composite joint of claim 1 wherein at least one of said pair of resin-impregnated fiber containing layers comprises a high tensile modulus fiber and said fiber-containing core layer comprises a roving, yarn, tow, poorly wetted or weakly bonded fibers.

5. The composite joint of claim 1 wherein said pair of resin-impregnated, fiber-containing layers are laminated to said fiber-containing core layer.

6. The composite joint of claim 5 further comprising a pair of polyolefin adhesive webs disposed between said fiber-containing core layer and each of said pair of resin-impregnated, fiber-containing layers for assisting in lamination.

7. The composite joint of claim 1 wherein said pair of resin-impregnated, fiber-containing layers and said fiber-containing core layer comprise two readily separable materials, amounting to at least 95 wt.% of said composite, for facilitating recyclability.

8. The composite joint of claim 7 wherein the fiber material of said pair of resin-impregnated, fiber-containing layers comprises a knit, woven of non-woven glass fabric having a basis weight of at least about 400 g/m², and the fiber material of the fiber-containing core layer comprises a woven or non-woven polymer fabric having a basis weight of at least 200 g/m².

9. An aircraft or motor vehicle body panel or door comprising the composite joint of claim 1.

10. The composite joint of claim 1 wherein said fiber-containing core layer comprises a thermoplastic yarn, roving, tow, woven or non-woven fabric, mat, scrim or web.

11. The composite joint of claim 10 wherein said fiber-containing core layer is impregnated with a resin.

12. An energy absorbent laminate comprising:

(a) a pair of composite layers containing a resin-impregnated glass fabric or mat having a first toughness;

(b) a core layer laminated between said pair of composite layers having a second toughness which is greater than said first toughness, said core layer having a greater elongation at break than said first layer;

said core layer helping to at least distribute loads due to shear, cutting and impact forces exerted on said composite.

13. The composite joint of claim 12 wherein said pair of composite layers comprise a woven or non-woven fabric or mat made of high tensile modulus fiber, and said core layer comprises a lower tensile modulus fiber, or a poorly wetted or weakly bonded high tensile modulus fiber, a roving, yarn, woven fabric, non-woven fabric, tow or combination thereof.

14. The composite joint of claim 12 wherein said core layer comprises low modulus polymeric filaments and filaments of at least one high modulus reinforcing fiber selected from the group comprising: glass fiber, carbon fiber, boron fiber, aramid fiber or a combination thereof.

15. A method of mechanically fastening a composite joint, comprising:

(a) providing a substrate material;

(b) providing a multi-layered composite, including:

(i) a pair of resin-impregnated, fiber-containing layers having a first toughness;

(ii) a fiber-containing core layer having a second higher toughness sandwiched between said pair of resin-impregnated, fiber-containing layers;

said substrate material and said multi-layered composite having aligned through-holes therein for receiving at least one mechanical fastener;

(c) disposing a mechanical fastener through said aligned through-holes of said multi-layered composite and said substrate material;

(d) fastening said mechanical fastener to join said substrate material to said multi-layered composite whereby said fiber-containing core layer helps to at least distribute shearout loads caused when said mechanical fastener is pulled in the direction of the plane of said multi-layered composite.

16. The method of claim 15 wherein said pair of resin-impregnated, fiber-containing layers are laminated to said fiber-containing core layer under heat, pressure, or both.

17. The method of claim 16 wherein said fiber-containing core layer comprises polymeric fibers and each of said pair of resin-impregnated, fiber-containing layers comprise glass fibers joined together in a roving, woven or non-woven fabric, yarn, tow, mat, scrim or combination thereof.

18. A multi-layered composite laminate, comprising:

(a) a pair of resin-impregnated, fiber-containing layers having a first flexural modulus and a first toughness;

(b) a fiber-containing core layer having a second, lower flexural modulus than said first flexural modulus and a second higher toughness than said first toughness, said fiber-containing core layer sandwiched between said pair of resin-impregnated, fiber-containing layers to form an integral composite;

(c) said integral composite having improved shearout resistance over a composite of approximately the same thickness made entirely from said resin-impregnated, fiber-containing layers having a first flexural modulus.

19. The composite of claim 18 wherein said pair of resin-impregnated, fiber-containing layers and said fiber-containing core layer comprise substantially similar fiber compositions, resin compositions, or both, for improved recyclability.

20. A multi-layered composite having improved energy absorbing properties comprising:

(a) a pair of resin-impregnated, fabric layers including high strength fibers;

(b) a core layer for absorbing energy directed to said composite by externally applied forces, said core layer comprising polymeric fibers having greater toughness than said high strength fibers, disposed in a roving, yarn, tow, knitted, woven or non-woven fabric, scrim or combination thereof, said core layer laminated between said pair of resin-impregnated glass fabric layers, under heat, pressure, or both, to form an integral composite.

21. The multi-layered composite of claim 20, wherein said core layer is only partially melted by said lamination.

22. A ballistic and explosion-resistant panel, comprising:

(a) a pair of resin impregnated, fiber-containing layers, having a first toughness;

(b) an aramid fiber-containing core layer having a second, greater toughness than said first toughness, said core layer sandwiched between said pair of resin impregnated, fiber-containing layers;

said multi-layered composite having improved resistance to ballistic impacts.

23. The panel of claim 21 wherein said aramid fiber-containing core layer comprises a woven or knit fabric.

24. The panel of claim 21 wherein said aramid fiber-containing core layer comprises a woven or non-woven fabric having a basis weight of at least 300-6,000 g/m^2.